

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application.

CLAIMS LISTING (all of presented claims 1-40)

**Claims 1-2: (Canceled).**

**Claim 3 (Currently Amended):** ~~The residue reducing method of Claim 1~~

A method for reducing micromasking residue remaining within an exposed interface region of an oxide-based hardmask layer and an underlying metal-containing anti-reflection coating layer (ARC layer) after the hardmask layer has been patterned, where the residue includes nodules containing one or more oxides and each having a base anchor portion and an upper body portion, the method comprising:

(a) providing a chemically reactive, first agent which will react with a first metal element of the metal-containing ARC layer to produce a volatile byproduct, the first agent being sufficiently small in size to operatively enter reaction zones of the base anchor portions of at least some of the residue nodules so as to react with the first metal element, if any, in the respective base anchor portions; and

(b) subjecting the residue nodules to a plasma including said chemically reactive, first agent; wherein

(a.1) said chemically reactive, first agent is selected from the group consisting of:  $\text{Cl}_2$ ,  $\text{HCl}$  and  $\text{BCl}_3$ .

**Claim 4 (Currently Amended):** ~~The residue reducing method of Claim 3~~ ~~4~~ wherein

(a.1) said first metal element is titanium.

**Claim 5 (Currently Amended):** ~~The residue reducing method of Claim 3~~ ~~4~~ wherein

(a.1) said oxide-based hardmask layer includes Plasma-Enhanced Tetra-Ethyl-OrthoSilicate (PE-TEOS).

**Claim 6 (Original):** The residue reducing method of Claim 5 wherein  
(a.2) said interface region is defined by the PE-TEOS material contacting the metal-containing ARC layer.

**Claim 7 (Currently Amended):** The residue reducing method of Claim 3 ~~4~~ wherein

(b.1) in addition to said chemically reactive, first agent said subjecting step subjects the residue nodules to a plasma further including one or more additional chemically reactive agents which can react with, and volatilize materials present in the base anchor portions of the residue nodules.

**Claim 8 (Currently Amended):** The residue reducing method of Claim 3 ~~4~~ and further comprising:

(c) providing a relatively, chemically nonreactive, second agent which does not substantially react with the first metal element of the metal-containing ARC layer to produce a volatile byproduct, the second agent being sufficiently large in average mass for physical bombardment purposes to operatively weaken attachments of the base anchor portions of the residue nodules to the interface region so as to thereby encourage break away and removal of the residue nodules from the interface region; and

(b.1) wherein in addition to said chemically reactive, first agent said subjecting step subjects the residue nodules to a plasma including said second agent.

**Claim 9 (Original):** The residue reducing method of Claim 8 wherein  
(a.1) said second agent is selected from the group consisting of: argon, helium, neon, krypton and nitrogen.

**Claim 10 (Original):** The residue reducing method of Claim 8 wherein

(b.2) said subjecting step includes establishing a first inflow rate for the first agent in the range of about 10 sccm to about 50 sccm.

**Claim 11 (Original):** The residue reducing method of Claim 10 wherein

(b.3) said subjecting step includes establishing a second inflow rate for the second agent in the range of about 50 sccm to about 150 sccm.

**Claim 12 (Original):** The residue reducing method of Claim 11 wherein

(b.2a) said subjecting step includes establishing the first inflow rate for the first agent in the range of about 15 sccm to about 25 sccm; and

(b.3a) said subjecting step includes establishing the second inflow rate for the second agent in the range of about 70 sccm to about 90 sccm.

**Claim 13 (Original):** The residue reducing method of Claim 11 wherein

(b.2b) said first agent is chlorine; and

(b.3b) said second agent is argon.

**Claim 14 (Original):** The residue reducing method of Claim 8 wherein

(b.2) said subjecting step includes establishing a plasma pressure range of about 2mT to about 15mT.

**Claim 15 (Original):** The residue reducing method of Claim 14 wherein

(b.2) said subjecting step includes establishing a plasma pressure range of about 6mT to about 12mT.

**Claim 16 (Original):** The residue reducing method of Claim 8 wherein

(b.2) said subjecting step includes establishing a plasma power in the range of about 300 watts to about 600 watts.

**Claim 17 (Original):** The residue reducing method of Claim 16 wherein

(b.2a) said subjecting step includes establishing for a chamber supporting said plasma, a pedestal bias power in the range of about 80 watts to about 200 watts.

**Claim 18 (Original):** The residue reducing method of Claim 8 wherein

(b.2) said subjecting step includes maintaining said plasma having said first and second agents for an effective residue reducing time of about 3 seconds to about 20 seconds.

**Claims 19-23: (Canceled).**

**Claims 24-26: (Canceled).**

**Claim 27 (Original):** The residue reducing method of Claim 8 wherein

a volumetric inflow ratio is established for respective inflow of the chemically reactive, first agent relative to inflow of the chemically nonreactive, second agent and said volumetric inflow ratio is in the range of about 1-to-10 (1:10) to about 4-to-10 (4:10).

**Claim 28 (Original):** The residue reducing method of Claim 27 wherein

said volumetric inflow ratio is in the range of about 2:10 to about 3:10.

**Claim 29 (Original):** The residue reducing method of Claim 28 wherein said volumetric inflow ratio is about 1:4 (25%).

**Claim 30 (Currently Amended):** The residue reducing method of Claim 29 wherein ~~said chemically reactive, first agent includes chlorine and~~ said chemically nonreactive, second agent includes argon.

**Claim 31 (Currently Amended):** The residue reducing method of Claim ~~3~~ 4 wherein said nodules form as clumps of residue material having an average diameter of about 100Å.

**Claim 32 (Currently Amended):** The residue reducing method of Claim ~~3~~ 4 wherein said nodules form as clumps of residue material having a maximum diameter of about 500Å each.

**Claim 33 (Currently Amended):** The residue reducing method of Claim ~~3~~ 4 wherein said nodules contain one or more oxides of titanium.

**Claim 34 (Previously Presented):** The residue reducing method of Claim 33 wherein said nodules contain fluorides of titanium.

**Claim 35 (Currently Amended):** A method for reducing micromasking residue remaining within an exposed interface region of an oxide-based hardmask layer and an underlying metal-containing anti-reflection coating layer (ARC layer) after the hardmask layer has been patterned with use of UV photolithography, where the residue includes nodules containing one or more oxides and each having a base anchor portion and an upper body portion, the method comprising:

(a) providing a chemically reactive, first agent which will react with a first metal element of the metal-containing ARC layer to produce a volatile byproduct, the first agent being sufficiently small in size to operatively enter reaction zones of the base anchor portions of at least some of the residue nodules so as to react with the first

metal element in the respective base anchor portions of the at least some nodules and the first agent including chlorine molecules;

(b') providing a relatively, chemically nonreactive, second agent which does not substantially react with the first metal element of the metal-containing ARC layer to produce a volatile byproduct, the second agent being sufficiently large in average mass for physical bombardment purposes at operative energies to operatively weaken attachments of the base anchor portions of the residue nodules to the interface region so as to thereby encourage break away and removal of the residue nodules from the interface region; and

(c') subjecting the residue nodules to a plasma including said chemically reactive, first agent and said chemically nonreactive, second agent, where the plasma physically bombards the upper body portions of the nodules with said second agent at said operative energies while chemically attacking the base anchor portions of the nodules with said first agent so as to thereby dislodge the nodules.

**Claim 36:** *(Canceled).*

**Claim 37** *(Currently Amended):* The method of Claim 35 ~~36~~ where the second agent includes argon.

**Claim 38** *(Currently Amended):* A residue removing method used between a fluorine-based dry etch of an oxygen-containing hardmask and a chlorine-based dry etch of a metal-containing anti-reflection coating layer (ARC layer) that directly underlies the hardmask, where the residue that is to be removed includes one or more oxides of said metal contained in the ARC layer, the removing method comprising:

subjecting the residue to a plasma that physically bombards top portions of the residue with nonreactive bombardment particles while simultaneously attacking base portions of the residue with chemically reactive particles that convert said metal into volatile byproducts where the nonreactive bombardment particles of the plasma include argon particles.

**Claim 39:** (*Canceled*).

**Claim 40** (*Currently Amended*): The method of Claim ~~39~~ 38 where the chemically reactive particles of the plasma include chlorine particles.

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